

Particle ID Working Group

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Tasks of PID Working Group

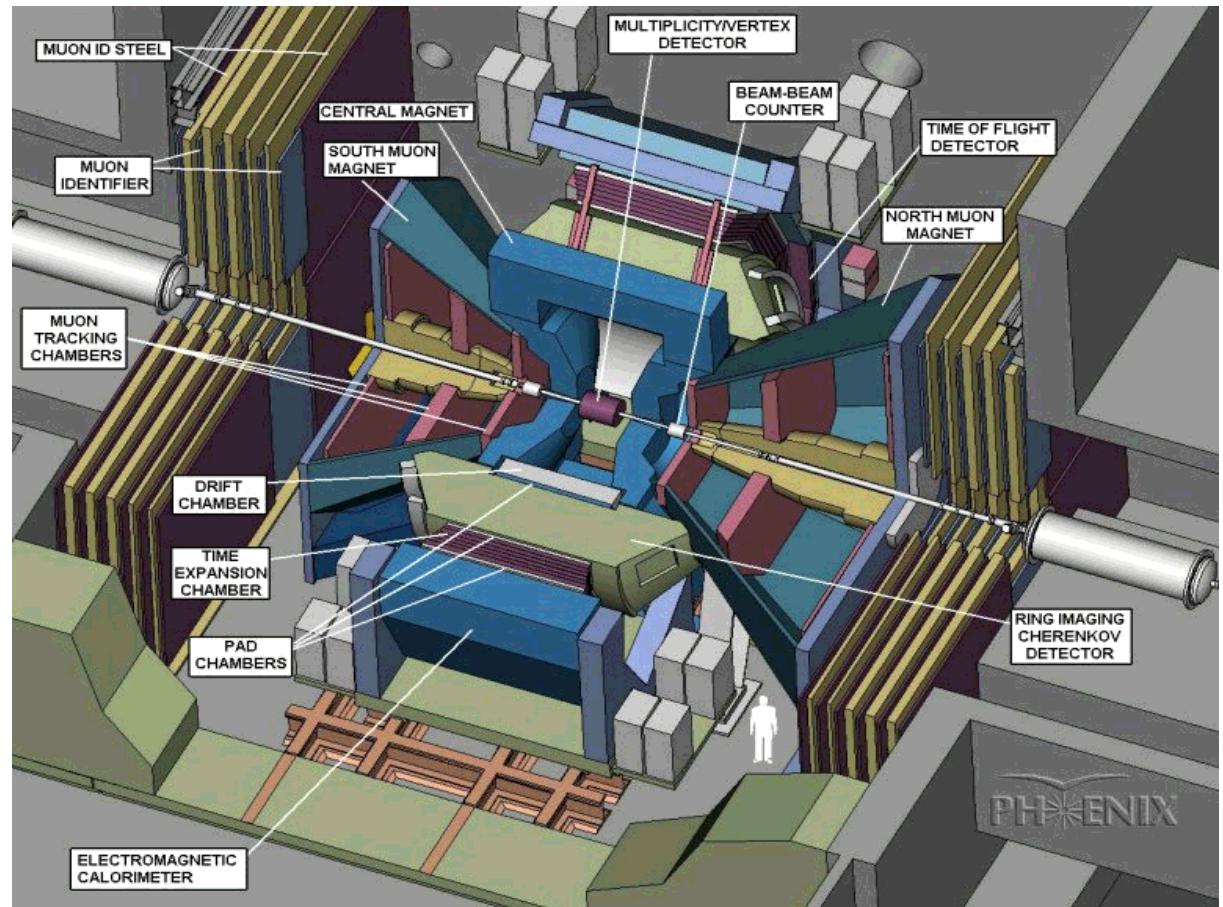
1. Review current PID capability for the experiments
2. Identify physics requirements
3. Locate PID candidates
4. Evaluate feasibility and/or readiness
5. Make plans;
 - R&D plans for the to-be-developed candidates
 - Short-term construction plans for matured devices

PID capability of PHENIX

Several PID devices in
the two central arms

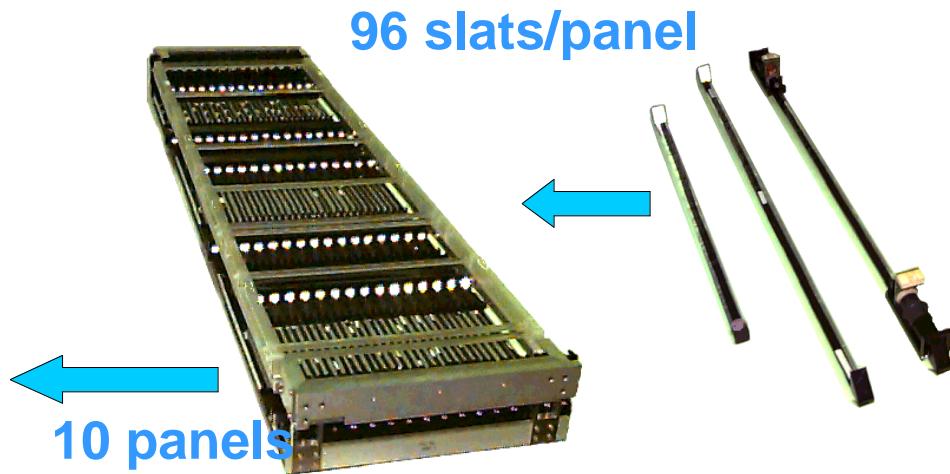
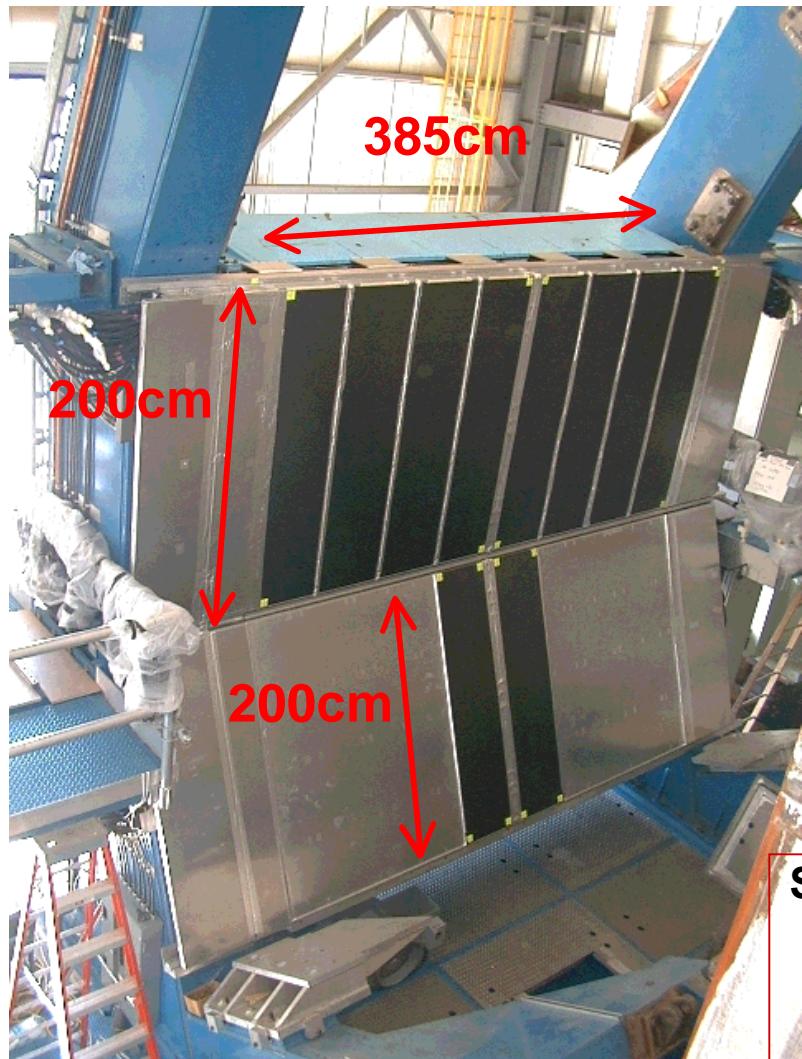
Two muon arms
-- muon ID

- hadron ID
 - TOF
 - EMCAL-TOF
- electron ID
 - RICH, EMCAL,
TEC, TOF
- photon ID
 - EMCAL



PHENIX-TOF

U. Tsukuba, NEVIS(Columbia U.) & BNL

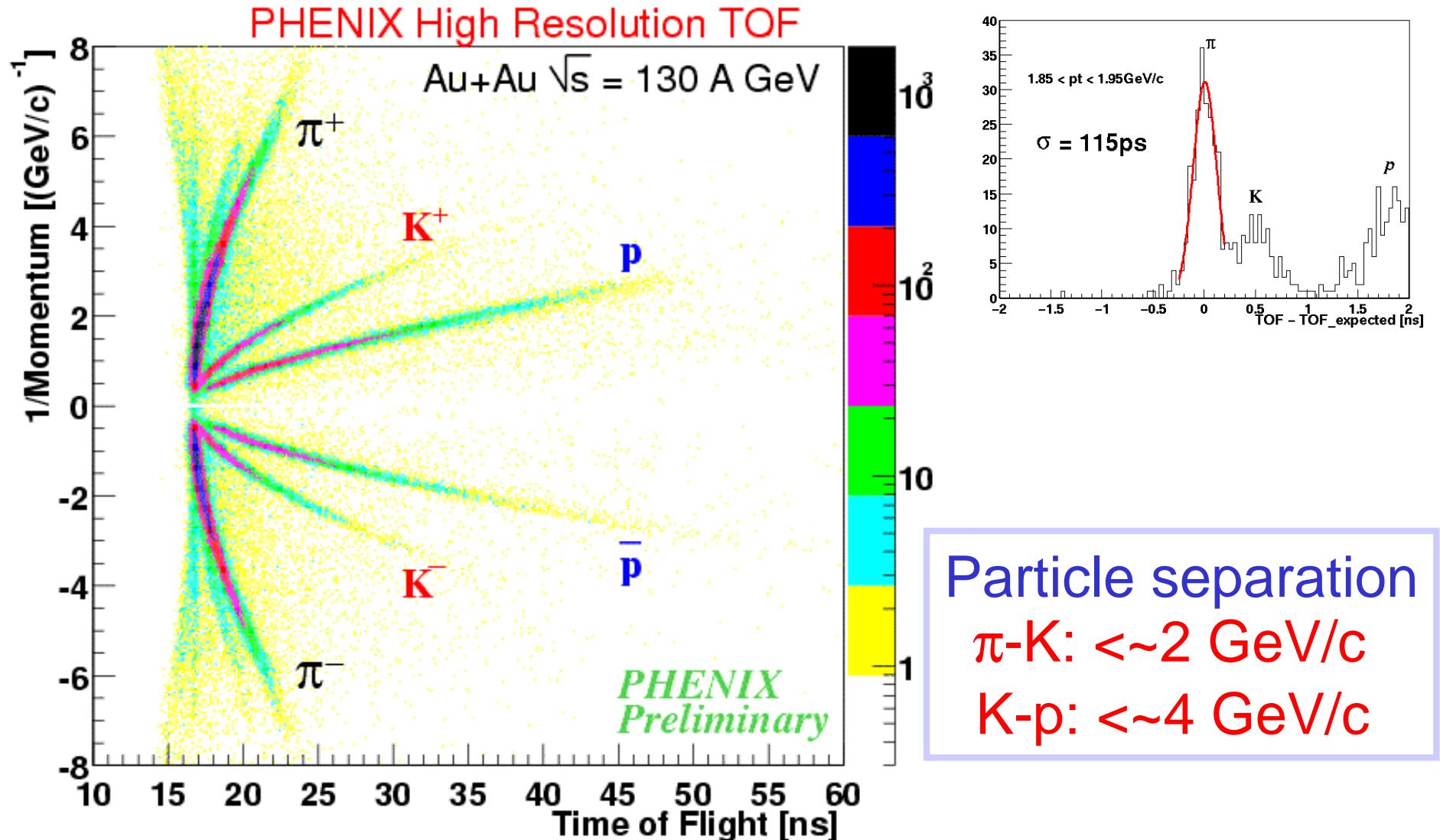


- * $\Delta\theta=40$ deg ($\Delta\eta = 0.7$), $\Delta\phi=45$ deg
for HBT and ϕ meson
- * 960 plastic scintillators(1920 PMTs)
for occupancy less than 10%

Scintillator: Bicron BC404
decay constant : 1.8 ns
attenuation length : 160cm

PMT: Hamamatsu R3478S
Rise time : 1.3 ns
Transit time : 14 +-0.36ns

Hadron PID and TOF resolution



Hadron-ID for higher pT

Particle separation

π -K: ~ 2 GeV/c

K-p: ~ 4 GeV/c

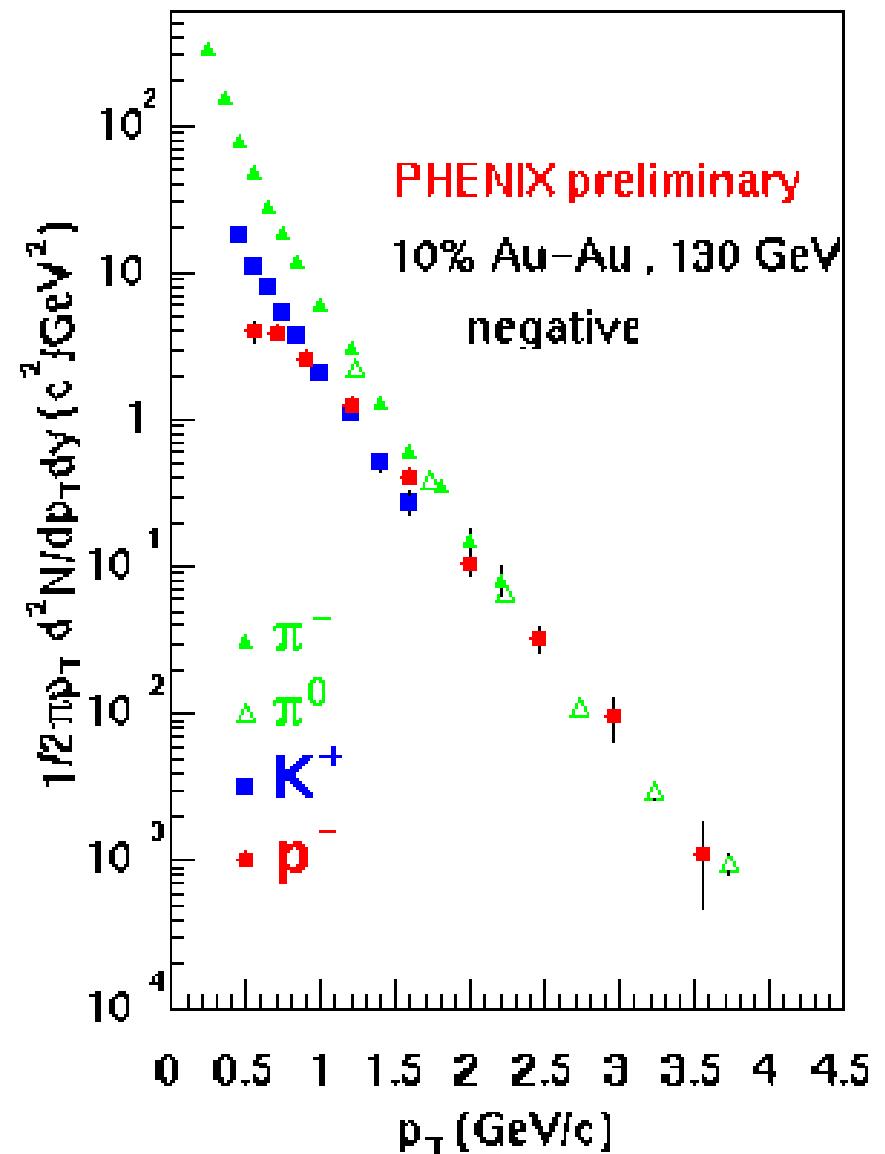
Higher pT

Motivation

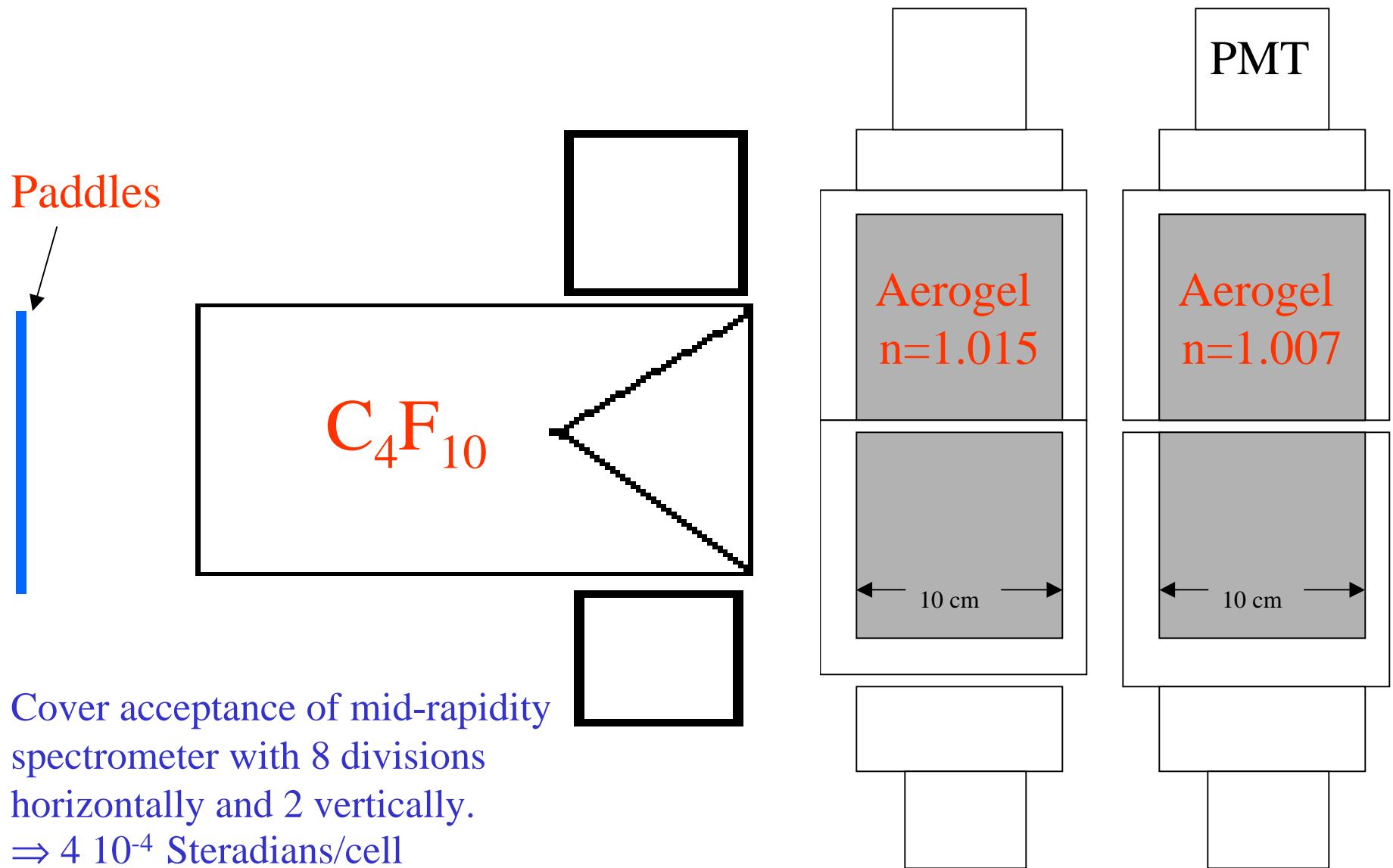
- jet quenching
 - Flavor dependence

Candidate

- Aerogel

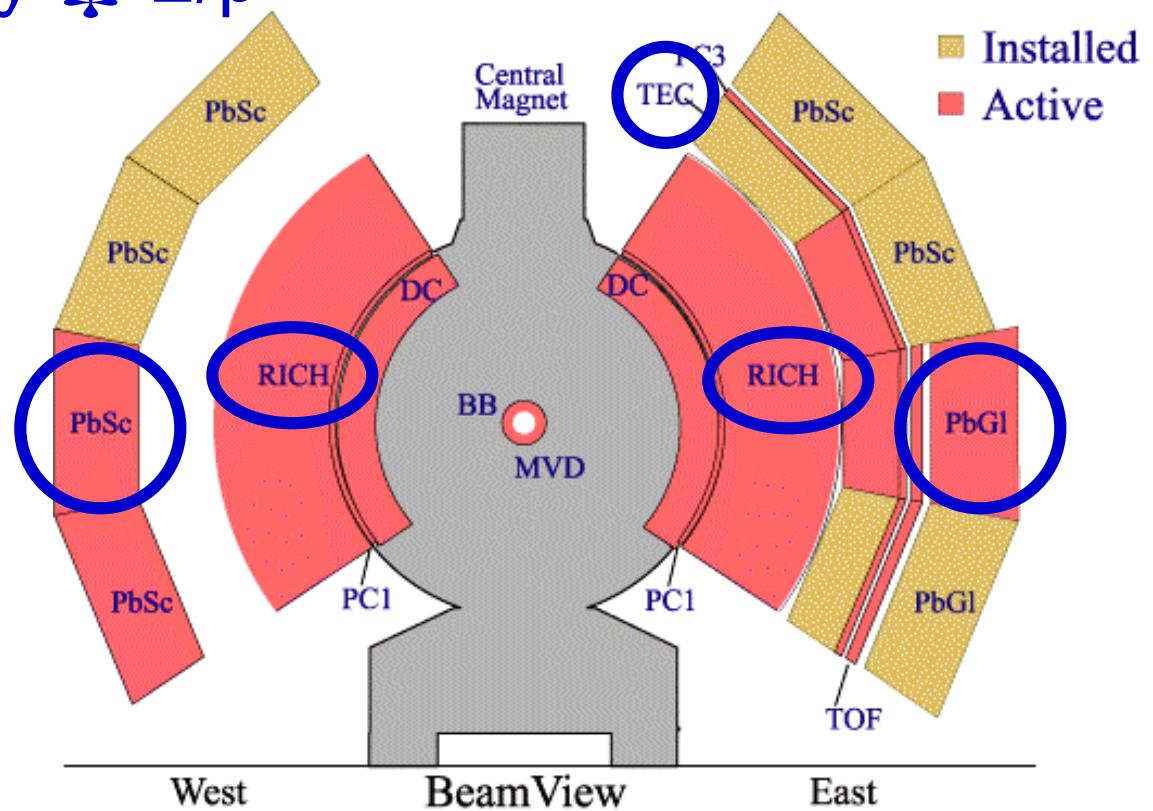


Idea of Cerenkovs at BRAHMS



Electron ID at PHENIX

- RICH --- gas Cherenkov
- TEC --- dE/dx
- EMCAL --- energy $\pm E/p$
- TOF



PHENIX Y2000 Configuration

PHENIX RICH

**BNL, CNS/U.Tokyo, FSU, KEK, SUNY/SB, NIAS,
ORNL, U.Tokyo, Waseda**

Primary device for electron ID

gas Cherenkov counter

- C_2H_6 ($\gamma_{th} \sim 25$) or CO_2 ($\gamma_{th} \sim 35$)
- eID p_t range : $0.2 \sim 4$ GeV/c

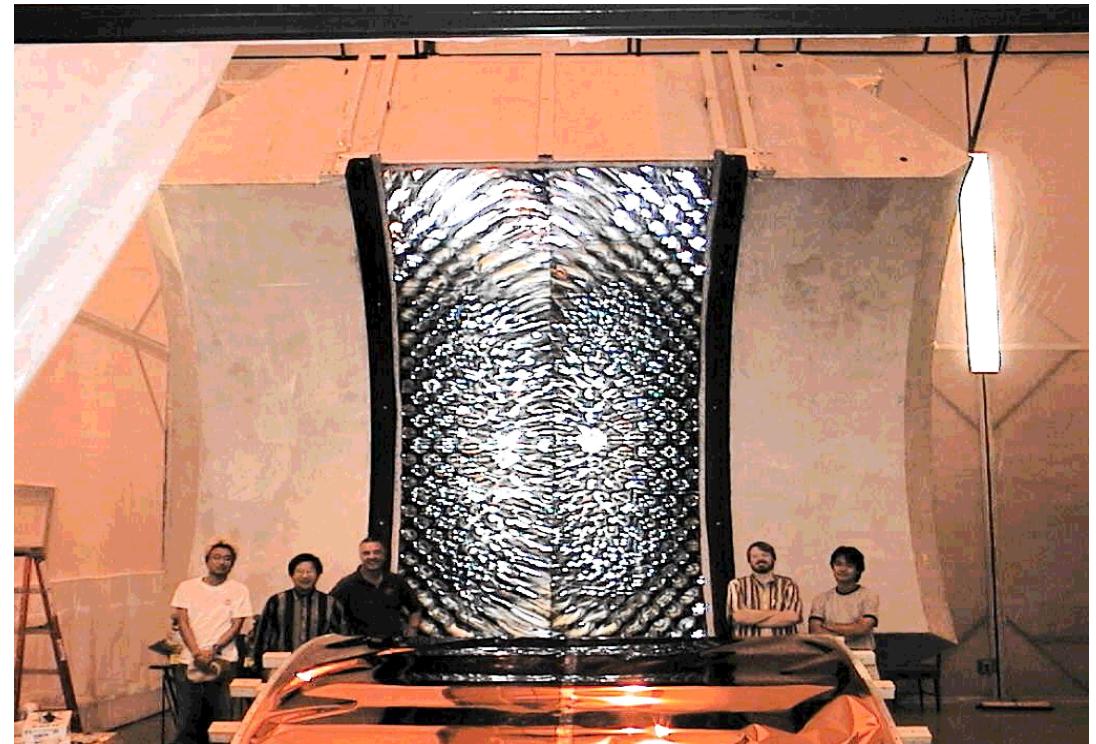
Gull-wing shaped spherical mirrors

Photon detection by PMT's

- 5,120 channels in 2 arms

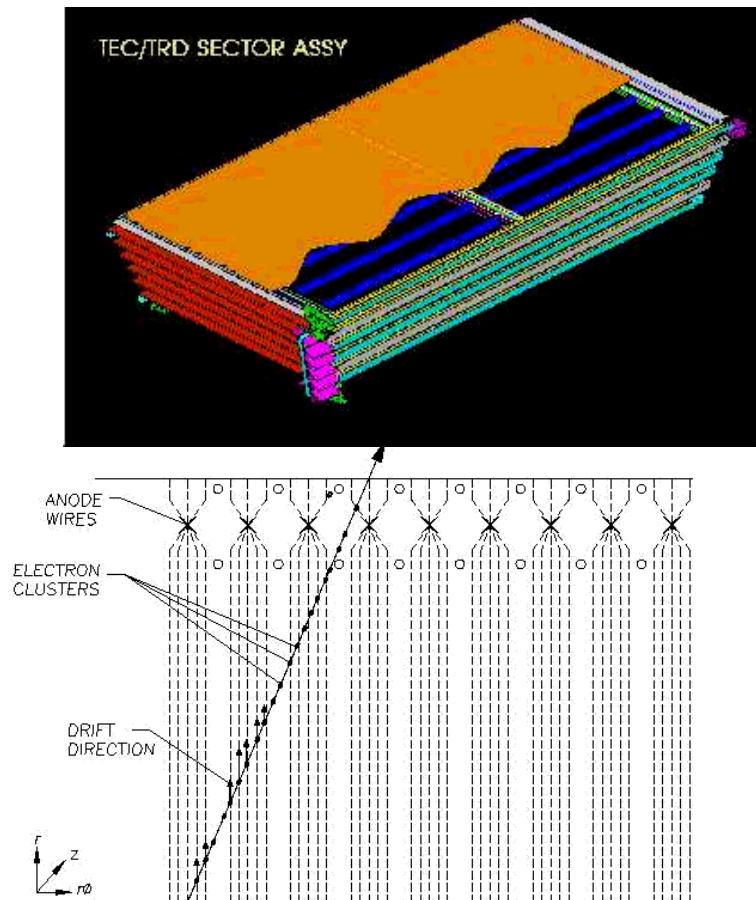
2-D angles (θ, ϕ) of electron tracks

- pixel size ~ 1 degree x 1 degree



Time Expansion Chamber

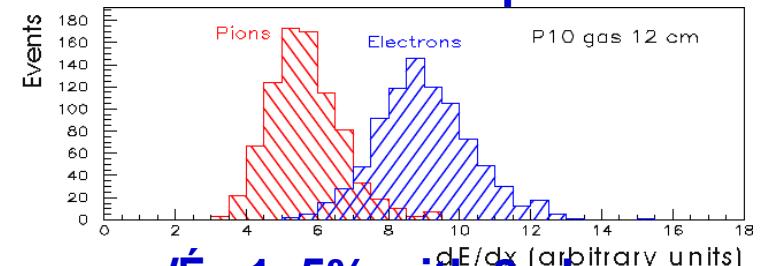
BNL, Academia Sinica(Taiwan), ISU, UC Riverside, U Sao Paulo



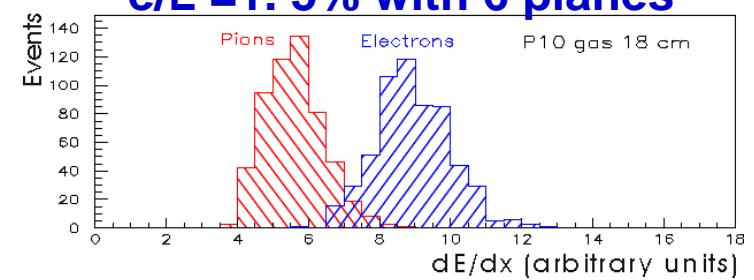
e/ \bar{E} Separation

(Test Beam at 500 MeV/c)

$e/\bar{E} = 5\%$ with 4 planes

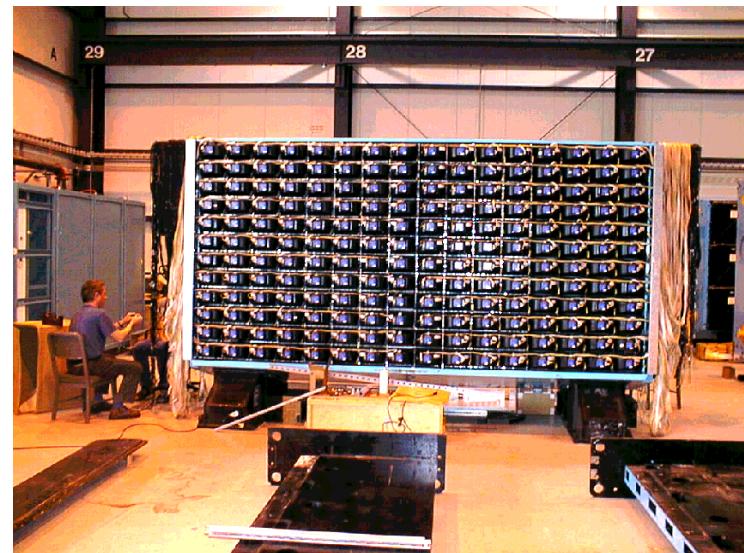
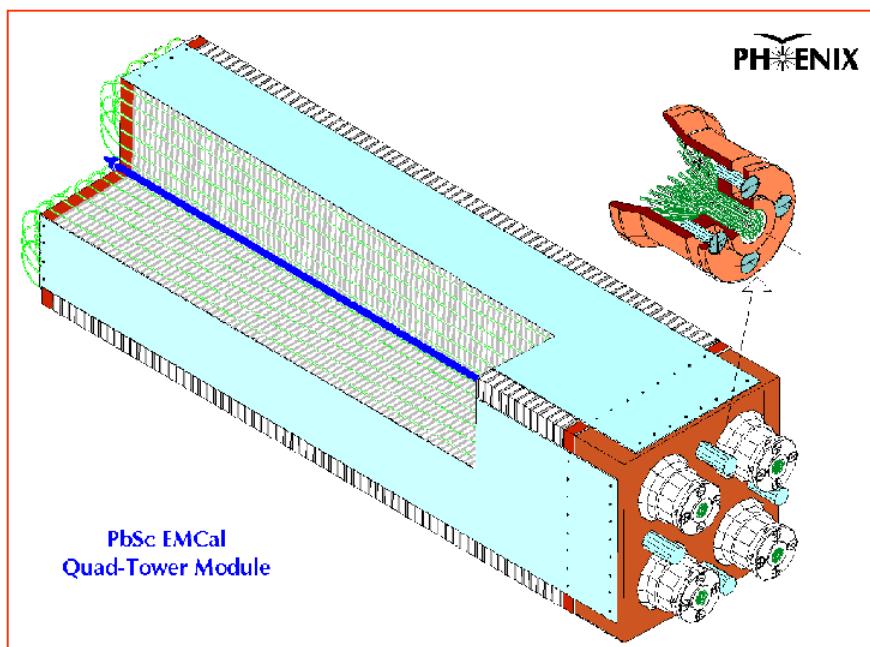
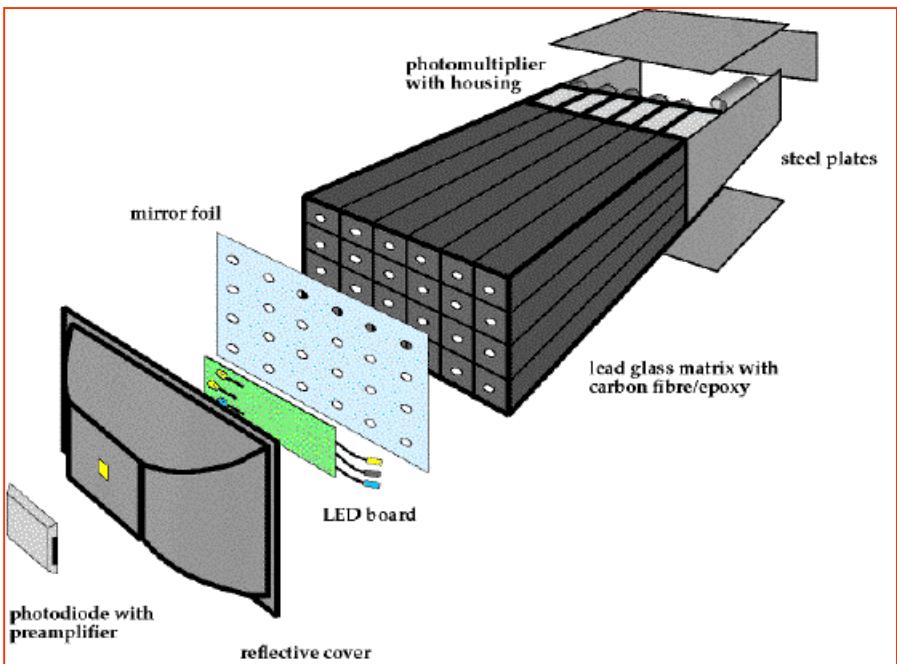


$e/\bar{E} = 1.5\%$ with 6 planes

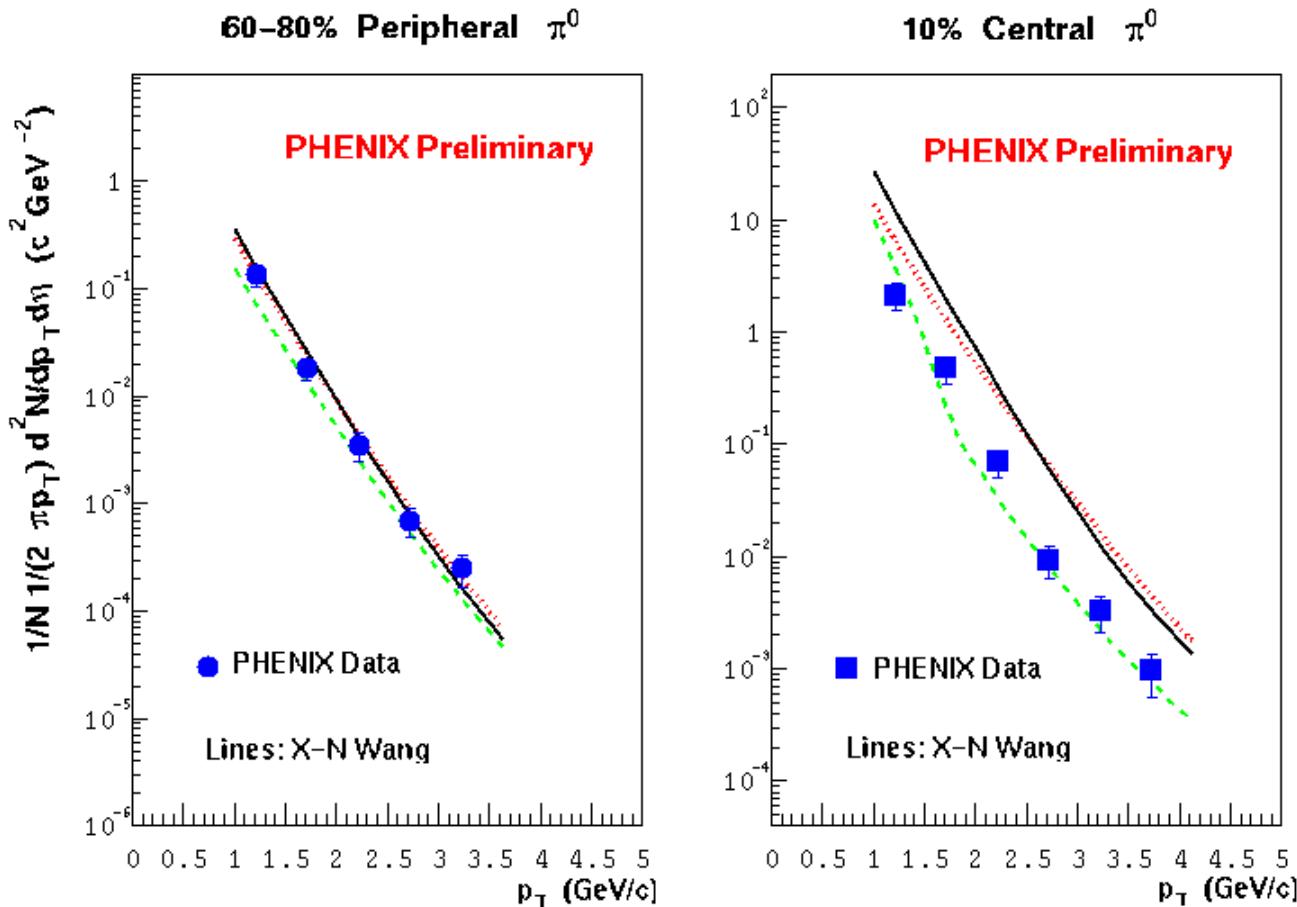


- Current TEC = $dE/dx \pm eID$ at low p
- Upgrade to TRD = eID at high p , not covered by RICH

Photon ID at PHENIX

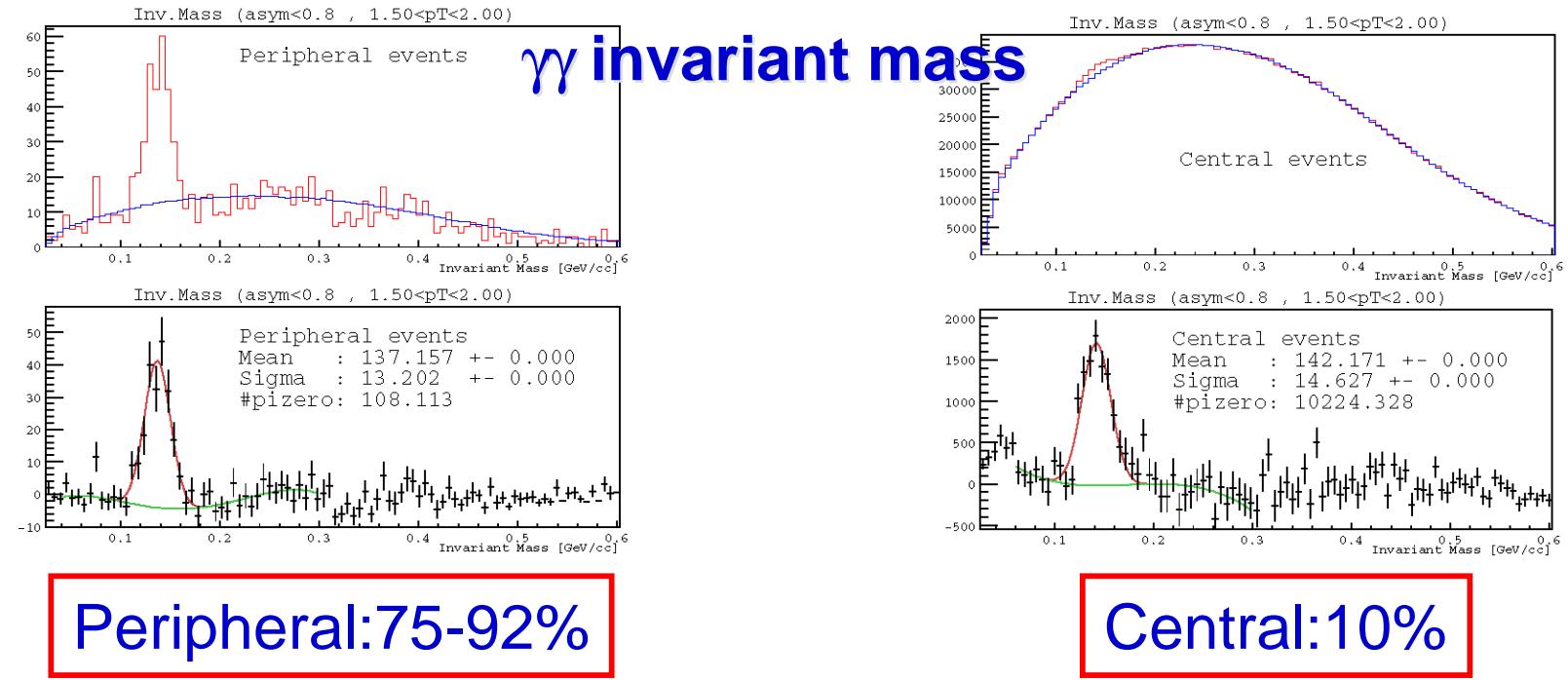


π^0 Spectra by PHENIX



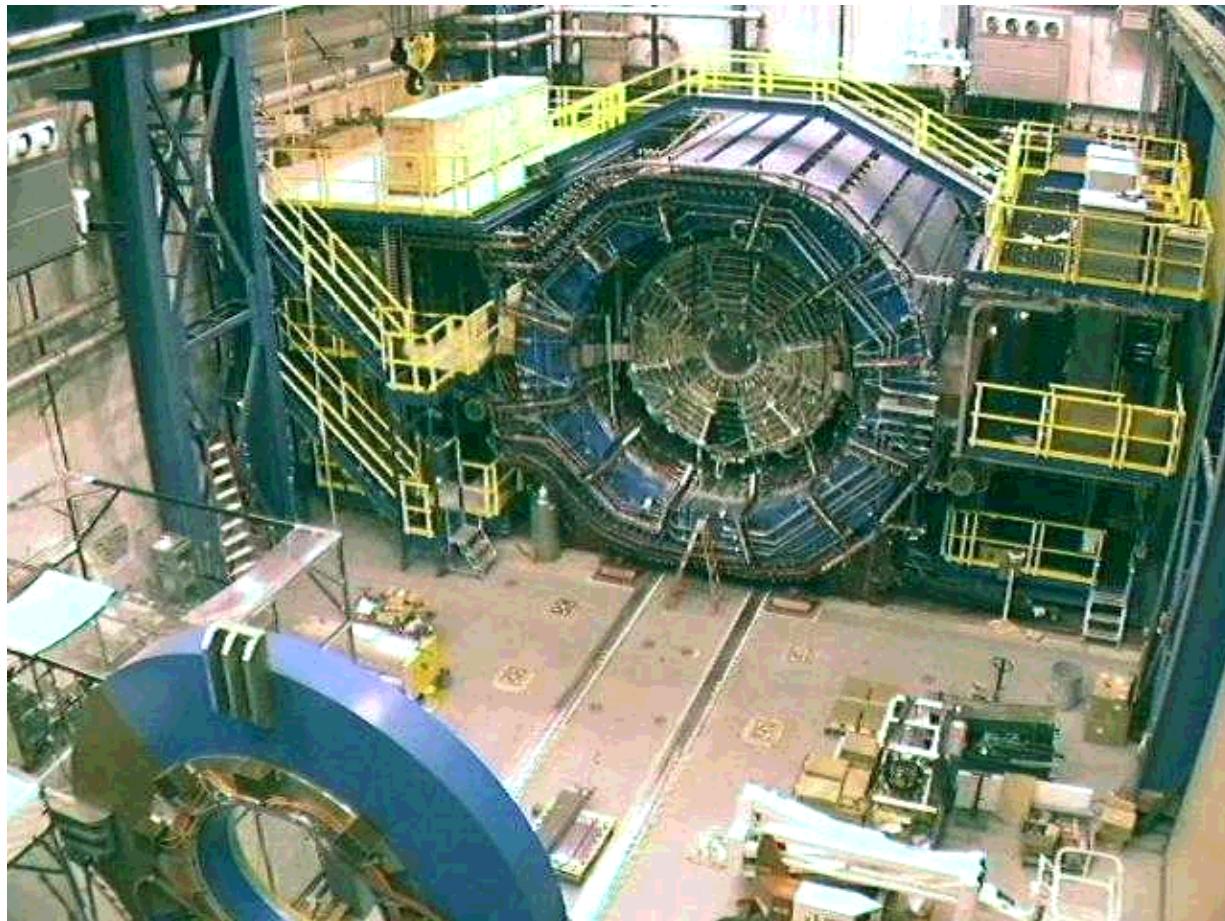
solid Åpp scaled with NBÅ@dottedÅshadowing+pT
broadening
dashedÅdotted + parton energy lossÅ0.25 GeV/fmÅ

EMCal as π^0 spectrometer



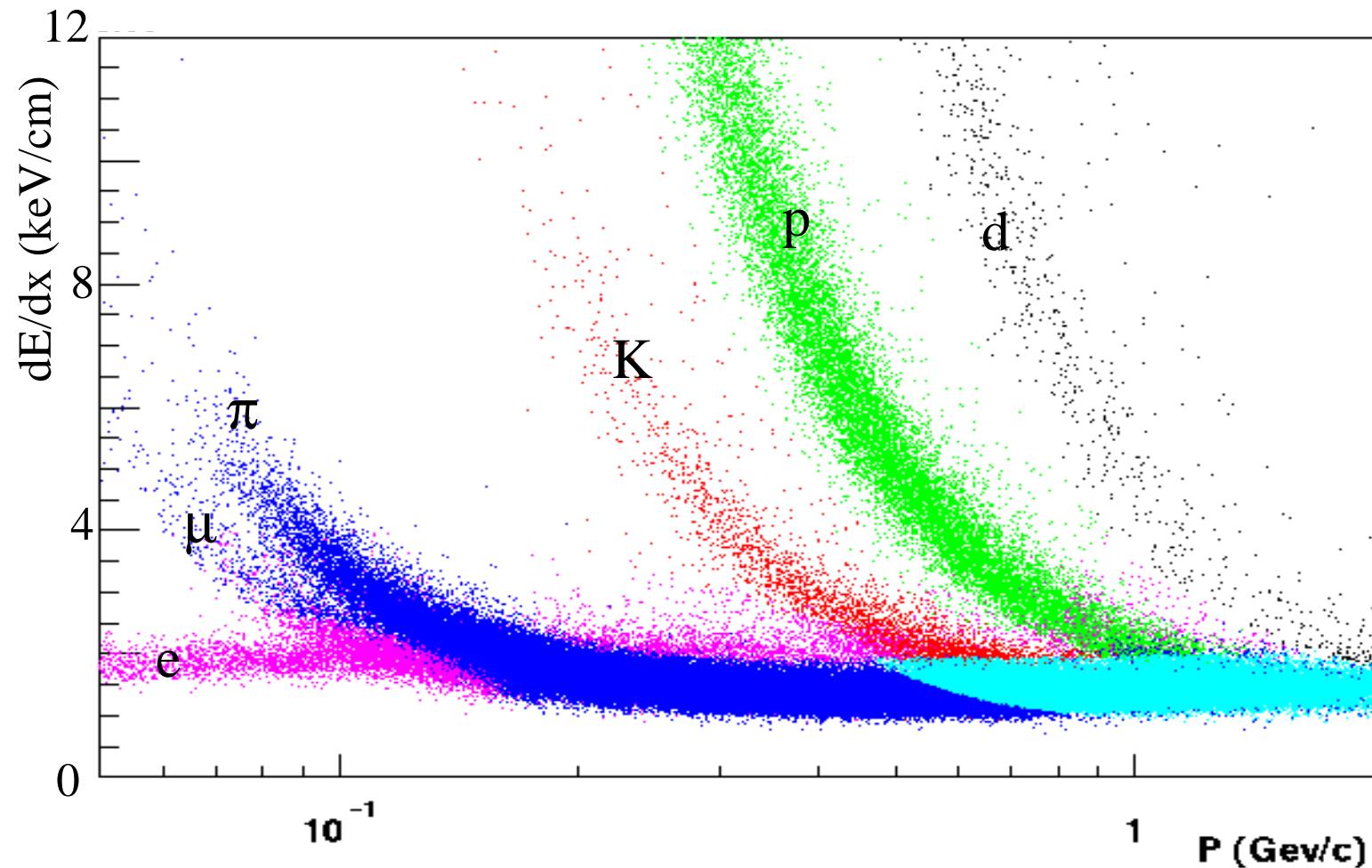
- High hit occupancy & moderate resolution
 ✖ unavoidable large systematic errors
- Better calorimeter
 - ✖ higher resolution & smaller Moliere radius
 - ✖ single photon with higher quality

STAR detector



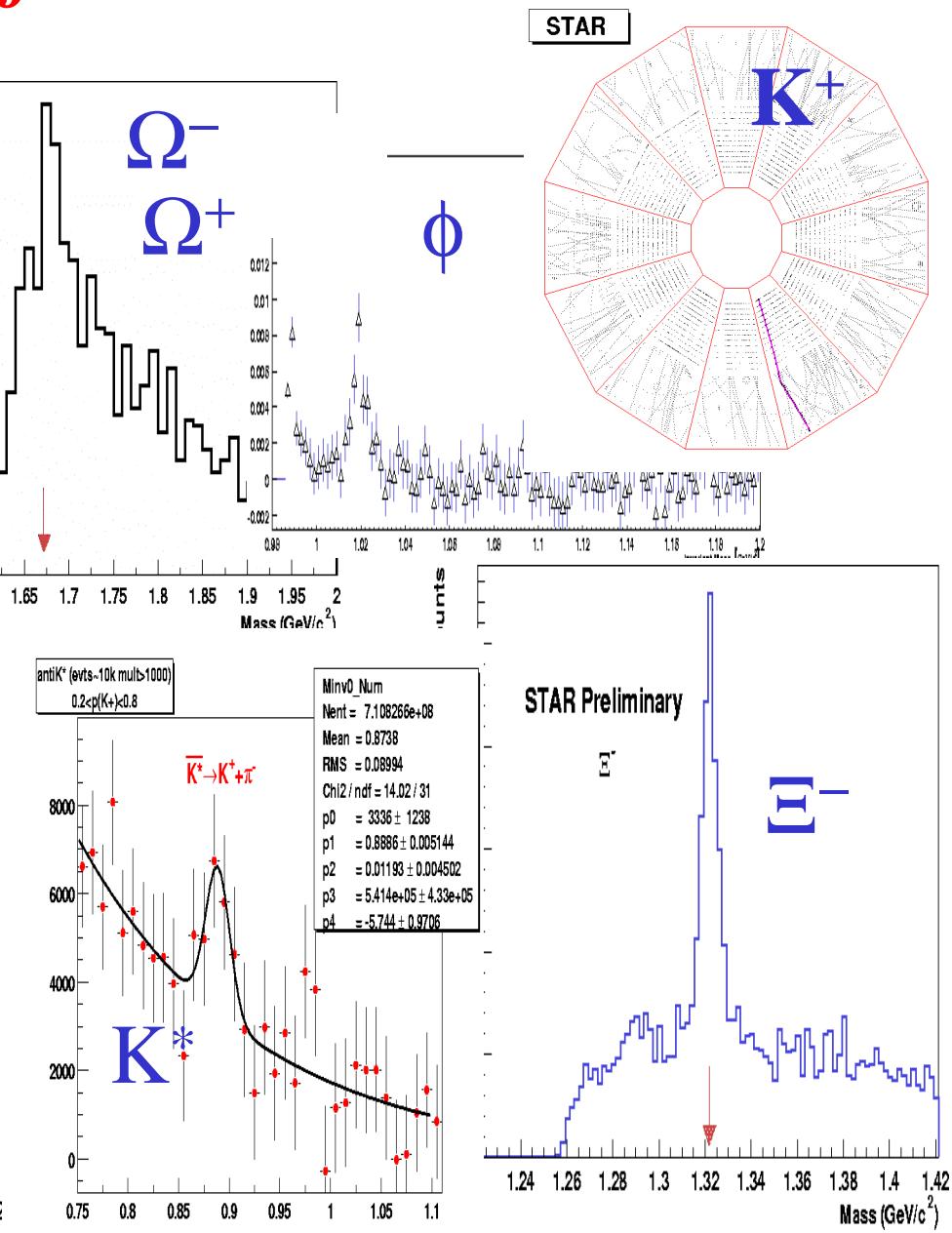
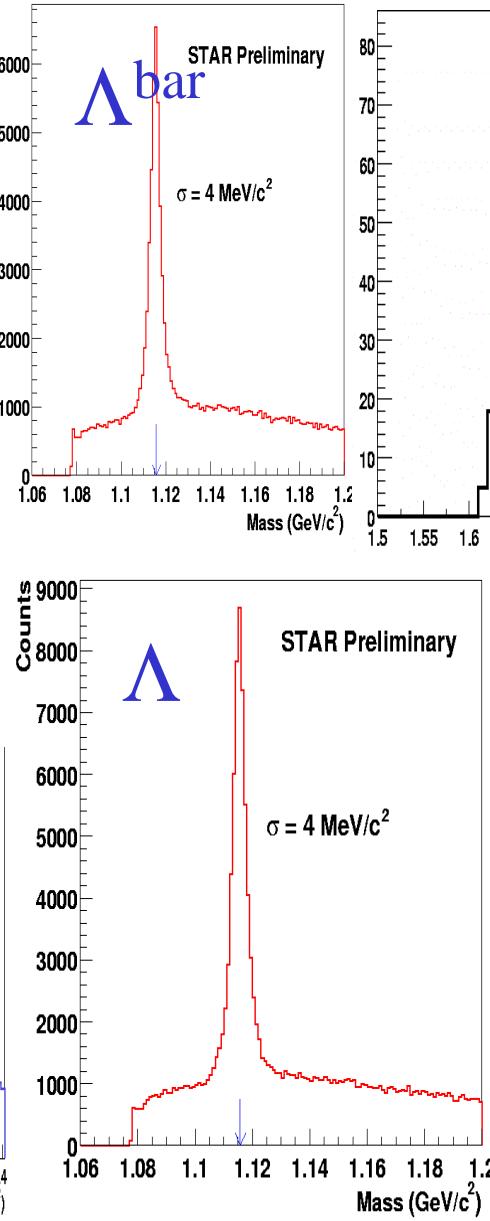
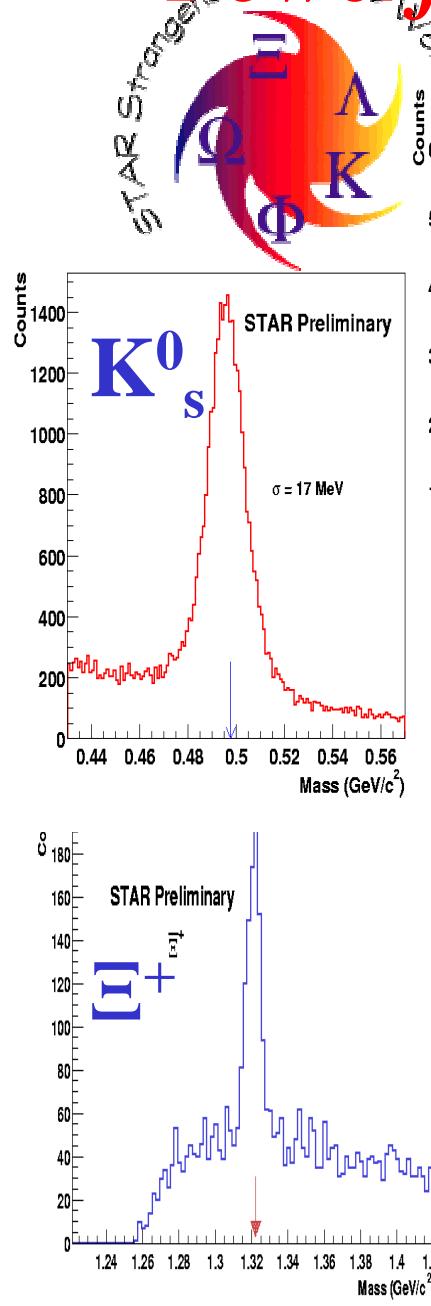
- 0.5 Tesla magnet
 - 0.25 for year 1
- Trigger
 - CTB
 - ZDC
 - Level 3
- Year 1 detectors
 - TPC
 - RICH
 - 1 SVT ladder

PID with TPC dE/dx



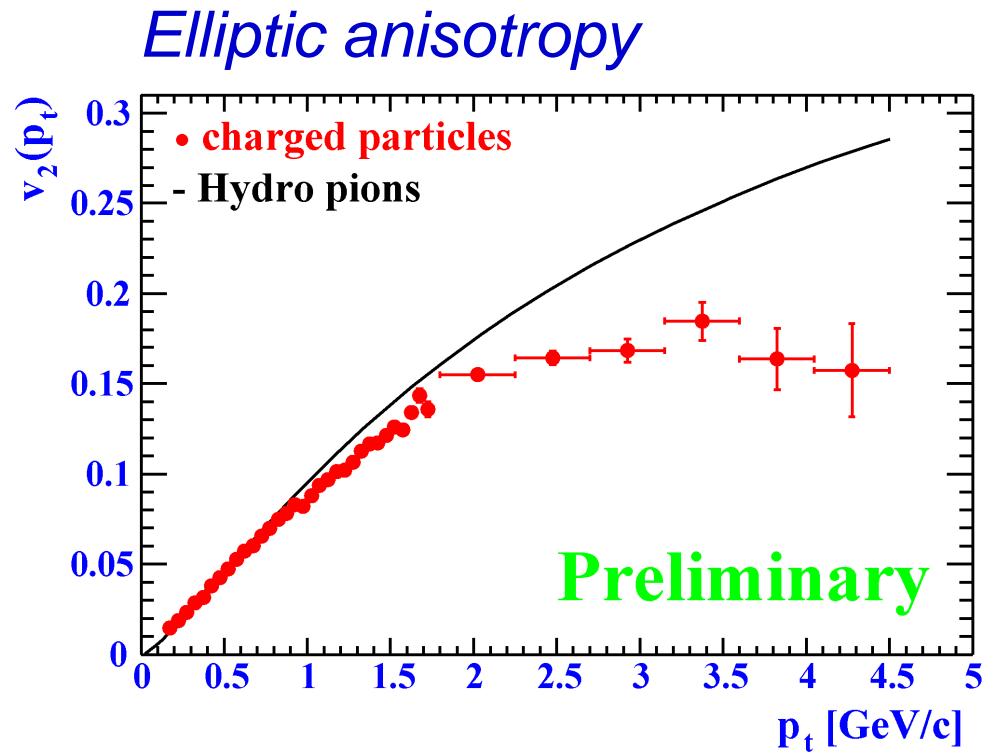
Low momentum region for single particles

Powerful for PID of STRANGENESS!



PID at higher momentum region

- May be related to “jet quenching effect”
- Better understanding with PID’ed anisotropy



Device candidates

- TOF – large area, cost effective solution
multi-step resistive plate chamber
- RICH with proper radiator (liquid)

Summary of PID Candidates

PID at higher momentum region

- Aerogel (+ TOF + ...)
 - PHENIX: high pT $\not\!\!\!\rightarrow$ jet quenching
 - BRAHMS: medium to high pT up to ~ 8 GeV/c
- Multi-step resistive plate chamber (MSRP)
 - STAR, ALICE: TOF in the large area
- Cherenkov counters
 - STAR, ALICE: PID at higher pT
- Photon Counter
 - PHENIX(?), ALICE: π^0 , single γ
- Transition radiation detector (TRD)
 - PHENIX, ALICE: eID at high pT

PID Working Group Members

- **Extended PID with Aerogel**

S. Esumi (Tsukuba), H. van Hecke (LANL), E. Kistenev (BNL),
Y. Miake (Tsukuba), M. Murray (Texas A&M), S. Sato (JSPS fellow),
S. Stoll (BNL)

- **Mutli-gap resistive plate chamber technology**

H-F. Chen(UST, China), G. Eppley (Rice), H. Huang (UCLA),
B. Llope (Rice)

- **Cherenkov detectors**

G. Kunde (Yale), B. Lasiuk (Yale)

- **Photon spectrometer**

T. Awes (ORNL), E. Kistenev (BNL), T. Sugitate (Hiroshima),
G.R. Young (ORNL), H.G. Ritter (LBNL),

- **Transition radiation detector (TRD)**

A. Andronic(GSI), H. Hamagaki(CNS/U.Tokyo), J. Stachel(Heidelberg)